Technical Document

2006 Utah Hospital Comparison
Hip/Knee Surgeries and Conditions: Charges, Quality and Patient Safety, 2002-2004

A Health Care Consumer's Report for Utahns

Office of Health Care Statistics
Health Data Committee
Utah Department of Health
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Introduction

Mandates for Publishing Utah Health Care Consumer's Reports:

Utah Senate Bill 132, titled "Health Care Consumer's Report," passed by the 2005 Utah Legislature, requires the Health Data Committee (HDC) to report health facility performance annually for consumers. The public consumer reports shall use nationally recognized quality and patient safety standards and facility charges for conditions or procedures. In December 2005, the HDC began to publish a series of hospital comparison reports on hospital charges, quality and patient safety.

Purpose of the Technical Documentation:

This technical documentation is one of a series of publications to provide technical information and methodological explanations on the Utah Health Care Consumer's Reports. Audience for this publication includes hospital personnel, health professionals, health data analysts and other interested professionals.

The Health Data Committee

Chapter 33a, Title 26, Utah Code Annotated established the thirteen-member Utah Health Data Committee. In accordance with the act, the committee's purpose is—

> *"to direct a statewide effort to collect, analyze, and distribute health care data to facilitate the promotion and accessibility of quality and cost-effective health care and also to facilitate interaction among those with concern for health care issues."*

The SB132 Health Care Consumer's Report Task Force

The Health Data Committee established the SB 132 Health Care Consumer's Report Task Force in 2005. The SB132 Task Force is a technical advisory group that provides consultation to the Utah Health Data Committee and its staff members in the Office of Health Care Statistics on measures, methods, and priorities for developing Health Care Consumer's Reports and related web reporting system.

Data Source

The Hospital Discharge Database

The data source for the Utah health care consumers' reports comes from the statewide hospital discharge database. Administrative Rule R428-10, titled "Health Data Authority, Hospital Inpatient Reporting Rule," mandates that all Utah licensed hospitals, both general acute care and specialty, report information on inpatient discharges. Since 1992, all hospitals have reported "discharge data" for each inpatient served.

"Discharge data" means the consolidation of complete billing, medical, and demographic information describing a patient, the services received and charges billed for each inpatient hospital stay. Discharge data records are submitted to the office quarterly. The data elements are based on discharges occurring in a calendar quarter.

Method of Reporting Charges

Use of APR-DRG, "All-patient Refined (APR)-Diagnosis Related Group (DRG)"

The APR-DRG, "All-patient Refined (APR)-Diagnosis Related Group (DRG)," classification system is used in the Utah healthcare consumer's reports to categorize discharge records into different diseases/conditions groups of patients.

- Diagnosis Related Group (DRG)

The DRGs were developed for the Health Care Financing Administration as a patient classification scheme which provides a means of relating the type of patients a hospital treats (i.e., its case mix) to the costs incurred by the hospital. While all patients are unique, groups of patients have common demographic, diagnostic and therapeutic attributes that determine their resource needs. All patient classification schemes capitalize on these commonalities and utilize the same principle of grouping patients by common characteristics.

The use of DRGs as the basic unit of payment for Medicare patients represents a recognition of the fundamental role a hospital's "sicker" patients play in determining resource usage and costs, at least on average. "The DRGs, as they are now defined, form a manageable, clinically coherent set of patient classes that relate a hospital's case mix to the resource demands and associated costs experienced by the hospital." (*Diagnosis Related Groups, Seventh Rev., Definitions Manual,* page 15.)

Each discharge in the Utah Health Discharge Database was assigned into a DRG based on the principal diagnosis, secondary diagnoses, surgical procedures, age, sex, and discharge status of the patient.

- All-patient Refined (APR)-DRG and Patient Severity Level

APR-DRG stands for All Patient Refined Diagnosis Related Group, software widely used in health services research. The APR-DRG software organizes about 20,000 clinical diagnoses and procedures into about 300 groups. Each APR-DRG has four severity levels. In the consumer reports, we use "Patient Severity Level" to group patients into one of two groups. The severity of illness and risk of mortality subclasses have levels of 1 to 4, indicating minor, moderate, major, and extreme, respectively.
In the consumer reports, patients who are assigned a minor or moderate level of patient severity are in the Minor/Moderate group, and patients who are assigned a major or extreme level of patient severity are in the Major/Extreme group. Patients whose care is classified as Major/Extreme are those who have multiple conditions, diseases, or illnesses or patients who are much sicker than other patients having the same procedure. This report uses APR-DRG version 20.0 for expected deaths, because AHRQ uses this version for risk adjustment in the Inpatient Quality Indicators. The report also uses APR-DRG version 20.0 for average charges.

Note that other Health Data Committee reports, such as the Utah Inpatient Hospital Utilization and

Charges Profile --Hospital Detail report for 2004 and previous years, use APR-DRG Version 15.0.

For details on APR-DRG go to: www.3m.com/us/healthcare/his/products/coding/refined_drg.jhtml

- ❑ Expected Death Percentage

Expected death percentage is the number of deaths expected per 100 patients with a certain hip condition or procedure if the hospital performed the same as other hospitals in the nation with similar patients. Expected death percentage adjusts for the hospital's case mix (patients' age, gender and how ill the patients are). For example, a hospital's hip replacement expected death percentage is the number of expected patient deaths per 100 hip replacement patients in that hospital if it performed like similar hospitals in the Health Care Cost and Utilization Project (HCUP) State Inpatient Databases for 2003. For more information on the AHRQ Inpatient Quality Indicators, see: www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_v30.pdf.

Excluding Outlier Cases from Calculating Hospital Average Charges

Some patients have exceptionally low or high lengths of stay or total facility (hospital) charges. A hospital's charges can be affected by just a few unusually long (or short) or expensive (or inexpensive) cases. These high or low values could be a result of coding or data submittal errors, particularly in length of stay, total charges, or data elements that affect APR-DRG assignments. Other reasons for exceptionally low charges could be due to death or transfer to another facility. Exceptionally high charges could be due to a catastrophic condition. Whatever the reason, these values, referred to as "outliers," distort the averages and were excluded from calculations. High charge outliers (facility) are defined in this and subsequent reports as values above 2.5 standard deviations from the state mean for each of the four levels of severity of illness for each APR-DRG. Means and standard deviations are APR-DRG specific and calculated on a statewide basis for a specific calendar year. For this report, the high outlier cases for both charge and length of stay are excluded from calculation of hospital average charges.

Facility Charge is Used for the Consumer's Reports

The Utah Hospital Discharge Database contains two types of charge summary information:

(1) Total Charges - Sum of all charges included in the billing form, including both facility charges and professional fees and patient convenience items. This is different from *cost* of treatment or *payment* received by the hospital. Cost of treatment can include additional care after the patient leaves the hospital.
(2) Facility Charges - Sum of all charges related to using a facility. Facility charge is calculated by subtracting professional fees and patient convenience item charges from total charge.

Payment received by the hospital may be less than the total charges billed for the patient's hospital stay due to contractual agreements with the insurance plans and/or charity/hardship programs available.

Average Charge:

This is the calculated average for all the services for which patients were billed as the facility charges at a particular hospital for a given condition or procedure. The average was calculated by adding the facility charges for all the services billed at that hospital for a given condition or procedure and then dividing by the total number of patients who were treated for that condition or procedure.

The method of calculating the average facility charge is identical to the method used in the HDC's standard report: Utah Hospital Utilization and Charge Profile -- Hospital Details, Table ST 1-3. In other words, both publications report average facility charges at APR-DRG and patient severity level without high outliers.

Sources of Quality and Safety Indicators

In compliance with SB 132, the Senate Bill for the Health Care Consumer's Report, the Utah Health Data Committee adopts "nationally recognized standards" for its public reporting on quality and safety. The federal government's agency in charge of health care quality, the Agency of Healthcare Research and Quality (AHRQ) has developed a set of Quality Indicators derived from hospital discharge data. Carolyn M. Clancy, M.D., Director of the federal Agency for Healthcare Research and Quality (AHRQ) has saluted Utah's efforts. She said, "AHRQ views public reporting as one important strategy to advance the quality improvement agenda in health care," Dr. Clancy added, "Evidence shows that publicly reporting performance by specific hospitals is a key element that promotes enhanced patient care." A document entitled "Guidance for Using the AHRQ Quality Indicators for Hospital-level Public Reporting or Payment" is available at: **http://www.qualityindicators.ahrq.gov/documentation.htm.**

The "hip/knee report" uses two of the AHRQ's Inpatient Quality Indicators.

Inpatient Quality Indicators (IQI]

These indicators were developed by the Agency for Healthcare Research and Quality (AHRQ) based on inpatient hospital discharge data. Although hospital discharge data does have some limitations, research has shown that IQIs may serve as proxies for utilization, quality, or patient outcomes. AHRQ IQI definitions and analytical methods were used to calculate the utilization and quality/safety indicators in this report. For more detailed information, go to **www.qualityindicators.ahrq.gov/**

This report includes two of the AHRQ Inpatient Quality Indicators.

Definitions and Codes for Each Indicator

Following pages are selected from "AHRQ Quality Indicators—Guide to Inpatient Quality Indicators: Quality of Care in Hospitals—Volume, Mortality, and Utilization. Rockville, MD: Agency for Healthcare Research and Quality, 2002. Version 3.0 (February 20, 2006).

5.14 Hip Replacement Mortality Rate (IQI 14)

Total hip arthroplasty (without hip fracture) is an elective procedure performed to improve function and relieve pain among patients with chronic osteoarthritis, rheumatoid arthritis, or other degenerative processes involving the hip joint.

Relationship to Quality	Better processes of care may reduce mortality for hip replacement, which represents better quality care.
Benchmark	State, regional, or peer group average.
Definition	Number of deaths per 100 patients with discharge procedure code of partial or full hip replacement.
Numerator	Number of deaths (DISP=20) with a code of partial or full hip replacement in any procedure field.
Denominator	All discharges with procedure code of partial or full hip replacement in any field. Age 18 years and older. Include only discharges with uncomplicated cases: diagnosis codes for osteoarthrosis of hip in any field. Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates)
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Procedures
Empirical Performance	Population Rate (2003): 0.29 per 100 discharges at risk
Empirical Rating	3

Summary of Evidence

Hip replacement is an elective surgery with relatively low mortality rates. However, the main recipients of hip replacement are elderly individuals with increased risk for complications and morbidity from surgery.

Although the low mortality rate is likely to affect the precision of this indicator, the precision is adequate for a quality indicator. Patient characteristics such as age and comorbidities may influence the mortality rate. Risk adjustment is highly recommended for this indicator, and providers may want to examine the case mix of their populations. This indicator should be considered with length of stay and transfer rates to account for differing discharge practices among hospitals.

Limitations on Use

Because hip replacement is an elective procedure, some selection of patient population may create bias. Risk adjustment for clinical factors, or at a minimum APR-DRGs, is recommended because of the confounding bias for hip replacement. In addition, little evidence exists supporting the construct validity of this indicator.

Details

Face validity: Does the indicator capture an aspect of quality that is widely regarded as important and subject to provider or public health system control?

Mortality for hip replacement is very low, as it should be for a procedure that is designed to improve function rather than extend survival. However, elderly patients are at a significant risk of post-operative complications such as pneumonia, osteomyelitis, myocardial ischemia, and deep vein thrombosis. If not recognized and effectively treated, complications may lead to life-threatening problems.

Precision: Is there a substantial amount of provider or community level variation that is not attributable to random variation?

Primary total hip arthroplasty is one of the most frequent types of major orthopedic surgery; about 160,000 were performed in the United States in 1998.[110] The relatively small number of deaths following total hip arthroplasty suggests that mortality rates are likely to be unreliable at the hospital level. Empirical evidence shows that this indicator is adequately precise, with a raw provider level mean of 1.2% and a substantial standard deviation of 5.7%.[111]

Relative to other indicators, a high percentage of the variation occurs at the provider level, rather than the discharge level. The signal ratio (i.e., the proportion of the total variation across providers that is truly related to systematic differences in provider performance rather than random variation) is low, at 20.0%, indicating that some of the observed differences in provider performance very likely do not represent true differences.

Minimal bias: Is there either little effect on the indicator of variations in patient disease severity and comorbidities, or is it possible to apply risk adjustment and statistical methods to remove most or all bias?

Hip replacement has the potential for selection bias caused by the decision to select surgery. The known predictors of in-hospital mortality include age, hip fracture, and the presence of any significant comorbidity.[112] [113]

Construct validity: Does the indicator perform well in identifying true (or actual) quality of care problems?

Using administrative data without any risk adjustment, Lavernia and Guzman found no association between hospital volume and mortality following total hip arthroplasty.[114] However, surgeons with fewer than 10 cases per year showed a significant increase in the death rate, and hospitals with fewer than 10 cases per year showed a significant increase in complications.

One observational study attributed a decrease in post-operative mortality (from 0.36% in 1981-85 to 0.10% in 1987-91) to changes in perioperative care, such as reduced intraoperative blood loss, more aggressive arterial and oximetric monitoring, and increased use of epidural instead of general anesthesia.[115]

Fosters true quality improvement: Is the indicator insulated from perverse incentives for providers to improve their reported performance by avoiding difficult or complex cases, or by other responses that do not improve quality of care?

All in-hospital mortality measures may encourage earlier post-operative discharge, and thereby shift deaths to skilled nursing facilities or outpatient settings.

Prior use: Has the measure been used effectively in practice? Does it have potential for working well with other indicators?

Hip replacement was included in the original HCUP QIs; it is also used by HealthGrades.com and the Greater New York Hospital Association.

[110]Popovic JR, Kozak LJ. National hospital discharge survey: annual summary, 1998 [In Process Citation]. Vital Health Stat 13 2000(148):1-194.
[111]Nationwide Inpatient Sample. Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. http://hcup.ahrq.gov/HCUPnet.asp.
[112]Kreder HF, Williams JI, Jaglal S, et al. Are complication rates for elective primary total hip arthroplasty in Ontario related to surgeon and hospital volumes? A preliminary investigation. Can J Surg 1998;41(6):431-7.
[113]Whittle J, et al. 1993.
[114]Lavernia CJ, Guzman JF. Relationship of surgical volume to short-term mortality, morbidity, and hospital charges in arthroplasty. J Arthroplasty 1995;10(2):133-40.
[115]Sharrock et al. 1995.

Hip Replacement Mortality Rate (IQI 14)

Numerator:

Number of deaths (DISP=20) with a code of partial or full hip replacement in any procedure field.

Denominator:

All discharges with a procedure code of partial or full hip replacement in any field.

Age 18 years and older.

ICD-9-CM hip replacement procedure codes:

8151	TOTAL HIP REPLACEMENT	0071	REV HIP REPL-ACETAB COMP OCT05-
8152	PARTIAL HIP REPLACEMENT	0072	REV HIP REPL-FEM COMP OCT05-
8153	REVISE HIP REPLACEMENT	0073	REV HIP REPL-LINER/HEAD OCT05-
0070	REV HIP REPL-ACETAB/FEM OCT05-		

Include only discharges with uncomplicated cases: diagnosis codes for osteoarthrosis of hip in any field.

ICD-9-CM osteoarthrosis diagnosis codes:

71500	GENL OSTEOARTHROSIS NOS	71595	OSTEOARTHROS NOS-PELVIS
71509	GENL OSTEOARTHROSIS MULT	71598	OSTEOARTHRO NOS-OTH SITE
71510	LOC PRIM OSTEOART-UNSPEC	71650	POLYARTHRITIS NOS-UNSPEC
71515	LOC PRIM OSTEOART-PELVIS	71655	POLYARTHRITIS NOS-PELVIS
71518	LOC PRIM OSTEOARTHR NEC	71658	POLYARTHRITIS NOS-OTH SITE
71520	LOC 2ND OSTEOARTH-UNSPEC	71659	POLYARTHRITIS NOS-MULT
71525	LOC 2ND OSTEOARTH-PELVIS	71660	MONOARTHRITIS NOS-UNSPEC
71528	LOC 2ND OSTEOARTHROS NEC	71665	MONOARTHRITIS NOS-PELVIS
71530	LOC OSTEOARTH NOS-UNSPEC	71668	MONOARTHRITIS NOS-OTH SITE
71535	LOC OSTEOARTH NOS-PELVIS	71690	ARTHROPATHY NOS-UNSPEC
71538	LOC OSTEOAR NOS-SITE NEC	71695	ARTHROPATHY NOS-PELVIS
71580	OSTEOARTHROSIS-MULT SITE	71698	ARTHROPATHY NOS-OTH SITE
71589	OSTEOARTHROSIS-MULT SITE	71699	ARTHROPATHY NOS-MULT
71590	OSTEOARTHROS NOS-UNSPEC		

Exclude cases:

- missing discharge disposition (DISP=missing)
- transferring to another short-term hospital (DISP=2)
- MDC 14 (pregnancy, childbirth, and puerperium)
- MDC 15 (newborns and other neonates)

5.20 Hip Fracture Mortality Rate (IQI 19)

Hip fractures, which are a common cause of morbidity and functional decline among elderly persons, are associated with a significant increase in the subsequent risk of mortality.

Relationship to Quality	Better processes of care may reduce mortality for hip fracture, which represents better quality.
Benchmark	State, regional, or peer group average.
Definition	Number of deaths per 100 discharges with principal diagnosis code of hip fracture.
Numerator	Number of deaths (DISP=20) with a principal diagnosis code of hip fracture.
Denominator	All discharges with a principal diagnosis code for hip fracture. Age 18 years and older. Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates)
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Conditions
Empirical Performance	Population Rate (2003): 3.18 per 100 discharges at risk
Empirical Rating	10

Summary of Evidence

Complications of hip fracture and other comorbidities lead to a relatively high mortality rate, and evidence suggests that some of these complications are preventable. Hip fracture mortality rate is measured with good precision, although some of the observed variance does not reflect true differences in performance. About 89% of hip fracture patients are elderly.

Patient age, sex, comorbidities, fracture site, and functional status are all predictors of functional impairment and mortality. Administrative data may not contain sufficient information for these risk factors.

Limitations on Use

Thirty-day mortality may be somewhat different than in-hospital mortality, leading to information bias. Mortality rates should be considered in conjunction with length of stay and transfer rates. Risk adjustment for clinical factors (or at a minimum APR-DRGs) is recommended. Limited evidence exists for the construct validity of this indicator.

Details

Face validity: Does the indicator capture an aspect of quality that is widely regarded as important and subject to provider or public health system control?

Hip fractures are associated with a significant increase in the subsequent risk of mortality, which persists for a minimum of 3 months among the oldest and most impaired individuals.[147] [148] Elderly patients often have multiple comorbidities and pre-fracture functional impairments. As a result, they are at significant risk of postoperative complications, which—if not recognized and effectively treated—can lead to life-threatening problems.

Precision: Is there a substantial amount of provider or community level variation that is not attributable to random variation?

The largest published study of in-hospital mortality reported a rate of 4.9% in 1979-88, which suggests that mortality rates are likely to

[147] Forsen L, Sogaard AJ, Meyer HE, et al. Survival after hip fracture: short- and long-term excess mortality according to age and gender. Osteoporos Int 1999;10(1):73-8.
[148] Wolinsky FD, Fitzgerald JF, Stump TE. The effect of hip fracture on mortality, hospitalization, and functional status: a prospective study. Am J Public Health 1997;87(3):398-403.

be relatively reliable at the hospital level.[149] Empirical evidence shows that this indicator is precise, with a raw provider level mean of 14.4% and a standard deviation of 16.0%.[150]

Relative to other indicators, a higher percentage of the variation occurs at the provider level, rather than the discharge level. The signal ratio (i.e., the proportion of the total variation across providers that is truly related to systematic differences in provider performance rather than random variation) is moderate, at 54.3%, indicating that some of the observed differences in provider performance likely do not represent true differences.

Minimal bias: Is there either little effect on the indicator of variations in patient disease severity and comorbidities, or is it possible to apply risk adjustment and statistical methods to remove most or all bias?

Demographic predictors of in-hospital or 30-day mortality include age, male sex, and prior residence in a nursing home. Fracture site may be a significant predictor for long-term outcomes. Comorbidity predictors include malnutrition; venous, digestive, and cardiovascular diseases; neoplasms, disorientation or delirium, chronic obstructive pulmonary disease, the number of chronic medical conditions, prior hospitalization within 1 month, and the American Society of Anesthesiology physical status score.

Empirical analyses confirm that this indicator has some potential bias, and risk adjustment with age and sex and APR-DRGs is highly recommended. Chart review may identify differences in functional status or other clinical factors not accounted for in discharge data.

Construct validity: Does the indicator perform well in identifying true (or actual) quality of care problems?

One study demonstrated that Medicare patients with poor "process of care" had similar risk-adjusted 30-day mortality rates as patients with good process of care.[151] Nevertheless, there is substantial evidence that at least two major causes of death among hip fracture patients are partially preventable: pulmonary emboli and acute myocardial infarction.[152] Very little evidence supports an association between hospital volume and mortality following hip fracture repair.

Empirical evidence shows that hip fracture repair mortality is positively related to pneumonia, stroke, gastrointestinal hemorrhage, and congestive heart failure mortality.[153]

Fosters true quality improvement: Is the indicator insulated from perverse incentives for providers to improve their reported performance by avoiding difficult or complex cases, or by other responses that do not improve quality of care?

All in-hospital mortality measures may encourage earlier post-operative discharge. Thirty-day mortality for hip fracture is substantially higher than in-hospital mortality in the largest published studies, suggesting that a relatively modest decrease in mean length of stay could significantly decrease inpatient mortality. Another potential effect would be to avoid operating on high-risk patients, although this seems unlikely.

Prior use: Has the measure been used effectively in practice? Does it have potential for working well with other indicators?

In-hospital mortality following hip fracture repair has not been widely used as a quality indicator, although it is included within a University Hospital Consortium indicator (mortality for DRG 209).

[149]Myers AH, Robinson EG, Van Natta ML, et al. Hip fractures among the elderly: factors associated with in-hospital mortality. Am J Epidemiol 1991;134(10):1128-37.
[150]Nationwide Inpatient Sample and State Inpatient Databases. Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/data/hcup/

[151]Kahn KL, Rogers WH, Rubenstein LV, et al. Measuring quality of care with explicit process criteria before and after implementation of the DRG-based prospective payment system. JAMA 1990;264(15):1969-73.
[152]Perez JV, Warwick DJ, Case CP, et al. Death after proximal femoral fracture—an autopsy study. Injury 1995;26(4):237-40.
[153]Nationwide Inpatient Sample.

Hip Fracture Mortality Rate (IQI 19)

Numerator:

Number of deaths (DISP=20) with a principal diagnosis code of hip fracture.

Denominator:

All discharges with principal diagnosis code for hip fracture.

Age 18 years and older.

ICD-9-CM hip fracture diagnosis codes:

82000	FX FEMUR INTRCAPS NOS-CL	82019	FX FEMUR INTRCAP NEC-OPN
82001	FX UP FEMUR EPIPHY-CLOS	82020	TROCHANTERIC FX NOS-CLOS
82002	FX FEMUR, MIDCERVIC-CLOS	82021	INTERTROCHANTERIC FX-CL
82003	FX BASE FEMORAL NCK-CLOS	82022	SUBTROCHANTERIC FX-CLOSE
82009	FX FEMUR INTRCAPS NEC-CL	82030	TROCHANTERIC FX NOS-OPEN
82010	FX FEMUR INTRCAP NOS-OPN	82031	INTERTROCHANTERIC FX-OPN
82011	FX UP FEMUR EPIPHY-OPEN	82032	SUBTROCHANTERIC FX-OPEN
82012	FX FEMUR, MIDCERVIC-OPEN	8208	FX NECK OF FEMUR NOS-CL
82013	FX BASE FEMORAL NCK-OPEN	8209	FX NECK OF FEMUR NOS-OPN

Exclude cases:

- missing discharge disposition (DISP=missing)
- transferring to another short-term hospital (DISP=2)
- MDC 14 (pregnancy, childbirth, and puerperium)
- MDC 15 (newborns and other neonates)

AHRQ Rates

The AHRQ Quality Indicators Software outputs several rates. The AHRQ Quality Indicators e-Newsletter, June 2005, provided guidance to users for appropriate rates to use for specific purposes.

QI Tips: Using Different Types of QI Rates

Which rate should you use, the observed (actual), expected, risk adjusted, and/or smoothed rates? Here are some guidelines.

If the user's primary interest is to identify cases for the health care provider's internal follow-up and quality improvement, then the **observed rate** would help to identify them. *The observed rate is the raw rate generated by the QI software from the data the user provided.* Areas for improvement can be identified by the magnitude of the observed rate compared to available benchmarks and/or by the number of patients impacted.

Additional breakdowns by the default patient characteristics used in stratified rates (e.g., age, gender, or payer) can further identify the target population. Target populations can also be identified by user-defined patient characteristics supplemented to the case/discharge level flags. Trend data can be used to measure change in the rate over time.

Another approach to identify areas to focus on is to compare the observed and **expected rates**. *The expected rate is the rate the provider would have if it performed the same as the reference population given the provider's actual case-mix (e.g., age, gender, DRG, and comorbidity categories).*

If the observed rate is higher than the expected rate (i.e., the ratio of observed/expected is greater than 1.0, or observed minus expected is positive), then the implication is that the provider performed worse than the reference population for that particular indicator. Users may want to focus on these indicators for quality improvement.

If the observed rate is lower than the expected rate (i.e., the ratio of observed/expected is less than 1.0, or observed minus expected is negative), then the implication is that the provider performed better than the reference population. Users may want to focus on these indicators for identifying best practices.

Users can also compare the expected rate to the **population rate** reported in the detailed evidence section of the IQI, PQI, or PSI Guide to determine how their case-mix compares to the reference population. If the population rate is higher than the expected rate, then the provider's case-mix is less severe than the reference population. If the population rate is lower than the expected rate, then the provider's case-mix is more severe than the reference population.

AHRQ uses this difference between the population rate and the expected rate to "adjust" the observed rate to account for the difference between the case-mix of the reference population and the provider's case-mix. This is the provider's **risk-adjusted rate**.

If the provider has a less severe case-mix, then the adjustment is positive (population rate > expected rate) and the risk-adjusted rate is higher than the observed rate. If the provider has a more severe case-mix, then the adjustment is negative (population rate < expected rate) and the risk-adjusted rate is lower than the observed rate. *The risk-adjusted rate is the rate the provider would have if it had the same case-mix as the reference population given the provider's actual performance.*

Finally, users can compare the risk-adjusted rate to the **smoothed** or "reliability-adjusted" rate to determine whether this difference between the risk-adjusted rate and reference population rate is likely to remain in the next measurement period. *Smoothed rates are weighted averages of the population rate and the risk-adjusted rate, where the weight reflects the reliability of the provider's risk-adjusted rate.*

A ratio of (smoothed rate - population rate) / (risk-adjusted rate - population rate) greater than 0.80 suggests that the difference is likely to persist (whether the difference is positive or negative). A ratio of less than 0.80 suggests that the difference may be due in part to random differences in patient characteristics (patient characteristics that are not observed and controlled for in the risk-adjustment model). In general, users may want to focus on areas where the differences are more likely to persist.

From http://qualityindicators.ahrq.gov/newsletter/2005-June-AHRQ-QI-Newsletter.htm#Headline3 (Accessed on January 18, 2006).

Statistical Tests and Rating System

Star Rating

The star rating system in the report is based on a test of statistical significance. This test shows whether the difference between a hospital's observed (actual) rate and the expected rate is real or just due to chance. For each indicator, the upper and lower 95% confidence intervals were calculated for each hospital's rate. The 95% confidence interval is the interval that one can be 95% certain contains the "true" hospital average. The 95% confidence interval for each hospital was then compared to the expected rate. If the lower limit of 95% confidence interval of a hospital rate is higher than the expected rate, that means the hospital rate is significantly higher than the expected rate. It is rated as one star, " * ". If the higher limit of 95% confidence interval of a hospital rate is lower than the expected rate that means the hospital rate is significantly lower than the expected rate. It is rated as three stars, " *** ". If a hospital's 95% confidence intervals overlap with the expected rate, the hospital rate is not significantly different from the expected rat, and is rated as two stars, " ** ". Keep in mind, however, that many factors affect the hospital's rates. For example, a hospital that cares for a lot of high-risk hip and knee surgery patients may have a higher rate of a quality or safety indicator, but that does not mean that the hospital delivers poor quality care.

95% Confidence Interval

The 95% confidence intervals of the observed (actual) rate are calculated using method of exact confidence intervals for the cumulative binomial distribution (Holubkov, 1998). This method is more appropriate for rates based on small numbers than other methods and is used in this report's rating system.

The statistical formulas to calculate standard errors and 95% confidence intervals are as follows:

[[Pi].sub.L]=x/(x+[n-x+1][F.sub..025,2n-2x+2,2x])
[[Pi].sub.U]=(x+1)/(x+1[n-x][[[F.sub..025,2x+2,2n-2x]].sup.-1])

Formula used in the Excel worksheet to calculate the values for the report:

95% CI LowerLimit = (x/(x+(n-x+1)*finv(0.025, (2*(n-x)), 2*x))*100
95% CI UpperLimit = ((x+1)/(x+1+(n-x)/finv(0.025, 2*x+2, 2*(n-x))))*100

Where:
[Pi].sub.L = Value of 95% Confidence Interval Lower Limit
[Pi].sub.U = Value of 95% Confidence Interval Lower Limit
x = numerator/number of events
n = denominator/number of risk population
F = F distribution
F.sub..025 = Selected critical value for 95% Confidence Interval

Reference: Holubkov, R. 1998 (August). "Analysis, assessment, and presentation of risk-adjusted statewide obstetrical care data: the StORQS II study in Washington State-Statewide Obstetrics Review and Quality System" published in Health Service Research.

Other health care consumer reports may use some of the following additional methods:

I. AHRQ Method for Calculating Standard Errors for the Actual [Observed) Rates

1) The root mean squared error (RMSE) for each QI for "Hospital J" is:

RMSE = sqrt(RATEij*(1-RATEij))

where RATEij is the observed rate for "QI #i" and "Hospital J"

2) The standard error on the observed rate for "Hospital J" is:

SE=RMSE/ SQRT (Nij)

where Nij is the denominator for "QI #i" and "Hospital J"

4) The 95% confidence interval on the observed rate for "Hospital J" for each QI is:

Lower confidence interval = "Hospital J" observed rate – (1.96 * SE)
Upper confidence interval = "Hospital J" observed rate + (1.96 * SE)

5) For example, if the rate for "Hospital J" for IQI #12 is Rate=0.10 and the denominator is N=200, then the lower bound 95% CI is:

0.10 - 1.96 * sqrt[(0.10 * (1-0.10)) / 200] =
0.10 - 1.96 * 0.021213 =
0.10 - 0.041578

and the upper bound 95% CI is:

0.10 + 1.96 * sqrt[(0.10 * (1-0.10)) / 200] =
0.10 + 1.96 * 0.021213 =
0.10 + 0. 041578

II. Calculating Standard Errors for the IQI Risk-adjusted Rates

Risk adjusted rates

1) Open the file IQI_V21_R4_RMSE.xls in the AHRQ Quality Indicator Software Package

2) The column labeled "RMSE" is the root mean squared error (RMSE) for each IQI based on the risk-adjustment model.

3) The standard error on the risk-adjusted rate for "Hospital J" is:

SE=SQRT(MSE/Nij) = RMSE/ SQRT (Nij)

where Nij is the denominator for "IQI #i" and "Hospital J"

4) The 95% confidence interval on the risk-adjusted rate for "Hospital J" for each IQI is:

Lower confidence interval = "Hospital J" risk-adjusted rate – (1.96 * SE)
Upper confidence interval = "Hospital J" risk-adjusted rate + (1.96 * SE)

5) For example, if the denominator for "Hospital J" for IQI #12 is N=200, then RMSE= 0.171757 and the lower bound 95% CI is:

rate - 1.96 * (0. 171757 / sqrt(200)) =
rate - 1.96 * 0.012145 =
rate - 0.023804

and the upper bound 95% CI is:

rate + 1.96 * (0. 171757 / sqrt(200)) =
rate + 1.96 * 0.012145 =
rate + 0.023804

Limitations

This report shows total billed facility charges. Billed charges are to be used as only one indicator of hospital performance. All patients, or insurance plans, do not pay the same amount for similar treatments, supplies, services, and procedures, even though they may be billed the same amount. Hospitals offer a variety of contracts, many with discount arrangements based on volume. Because of this, the data reflects pre-contractual prices for hospitalization and not the actual payment between providers and payers.

This report can be used to compare broad measures of utilization for all hospitals, but more detailed data are needed to look at specific performance comparisons between hospitals. This information serves as an important first step toward consumers' taking a more active role in health care decision-making.

The price of hospital services, while important, is not the only consideration in making inpatient hospital decisions. Other factors that may influence hospital services, including: the type of condition treated, the physicians who practice at the hospital, and the insurance company's managed care policies. The subscriber should be familiar with his or her health plan long before hospital care is needed. (For additional information on managed care performance please contact the Office of Health Care Statistics at (801) 538-7048.)

Bilateral Knee Joint Replacement

Some patients can have bilateral knee joint replacements, that is, both right and left knee joint replacement surgeries during a single hospital stay. Advantages include less total time in the hospital -- less time than for two separate hospital stays for one knee replacement at a time. Disadvantages include greater stress on the patient from two

major surgeries at the same time. Also, bilateral knee joint patients need more assistance after surgery, such as longer stays in rehabilitation or nursing facilities. Surgeons usually consider only patients who are physically strong, otherwise in good health and slender for bilateral knee joint replacements.

In Utah, 5,328 inpatients had knee replacements in 2004. Of these, 351 (7%) inpatients had bilateral total knee joint replacement. The 336 inpatients with minor/moderate severity of illness had an average hospital charge of $42,290 and an average length of stay of 4.9 days. The 15 inpatients with major/extreme severity of illness had an average hospital charge of $51,557 and an average length of stay of 7.1 days. These averages include patients with high outlier hospital charge and high outlier length of stay, because bilateral joint replacements tend to be among the most expensive and lengthy knee replacement hospitalizations. The averages do not include revision of knee joint replacement.

Bilateral Hip Joint Replacement

Though less common than bilateral knee joint replacement, some patients can have bilateral hip joint replacements, that is, both right and left hip joint replacement surgeries during a single hospital stay. Advantages include less total time in the hospital -- less time than for two separate hospital stays than for one hip replacement at a time. Disadvantages include greater stress on the patient from two major surgeries at the same time. Also, these patients need more assistance after surgery, such as longer stays in rehabilitation or nursing facilities. Surgeons usually consider only patients who are physically strong, otherwise in good health and slender for bilateral knee joint replacements. Also, bilateral hip joint replacement surgery requires specialized surgical equipment and instruments.

In Utah, 3,095 inpatients had hip replacements in 2004. Of these, 16 (0.5%) inpatients had bilateral knee joint replacement. These patients had any combination of total or partial hip joint replacements, that is, both total hip joint replacements, both partial hip joint replacements and one total and one partial hip joint replacement. The seven inpatients with minor/moderate severity of illness had an average hospital charge of $53,633 and an average length of stay of 8.4 days. The 9 inpatients with major/extreme severity of illness had an average hospital charge of $54,565 and an average length of stay of 8.7 days. These averages include patients with high outlier hospital charge and high outlier length of stay, because bilateral joint replacements tend to be among the most expensive and lengthy knee replacement hospitalizations. The averages do not include revision of hip joint replacement.